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ABSTRACT

This paper examines how three preservice teachers, who previously worked in science-related fields, confronted barriers in the process of becoming science teachers. Many of the barriers these teachers faced were similar to the barriers that more traditional teacher education candidates faced, but they also faced some barriers that were less common for traditional preservice teachers. Specific barriers explored include contextual issues related to family, finance, employment, and time; institutional concerns as in returning to school as an undergraduate; vocational concerns related to shifting views of profession and identity; and intellectual barriers such as the misfit of science discipline areas to school science. The three case studies presented in this paper demonstrate how barriers overlap and interact in a wide variety of ways to influence experiences in a teacher education program on into the beginning year of a new career. (DDR)

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Confronting the Barriers of Moving from "Doing Science" to "Teaching Science"

or

"I can't believe how much work all of this is....": Moving from Doing Science to Teaching Science

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Confronting the Barriers of Moving from "Doing Science" to "Teaching Science"

The shortage of qualified science and mathematics teachers is widely reported and accepted throughout the general public. The nature of this shortage and the severity of the shortage varies from region to region, but in general, the public accepts that this is a fact. In many states, emergency or provisional teacher certification is given to anyone holding a bachelors degree in a science related field. Most individuals will also shift careers an average of 3-4 times during their working during their life times.

Given this set of conditions it should come as no surprise that individuals who choose leave science related careers, because of a wide variety of circumstances, often consider entering the teaching profession. These individuals have worked in the "real world of science" and bring to the classroom a working rather than academic view of science. The arguments about effective teaching practices as discussed in reform efforts such as the national reforms (National Research Counsel 1996; American Association for the Advancement of Science, 1989) are not familiar to them, and often have very little value to them.

Each year colleges and universities receive inquiries from individuals who wonder what they would have to do to become a certified or licensed science teacher. Few universities have specific programs designed to meet the unique needs of this population. Generally a program is put together of a combination of undergraduate and/or graduate level courses. This paper follows three individuals as they progress through a liscensure program at a mid-size urban campus in the south east part of the United States.

Specifically this paper will examine how these future teachers, and now practicing teachers, confronted some of the barriers they faced in becoming a science teacher. Many of the barriers these teachers face are similar to more traditional teacher education candidates, but they also face some barriers less common in traditional pre-service teachers. Specific barriers that will be explored in this paper are:

- *Contextual -- Issues of family, finance, employment and time.*
- *Institutional -- Coming back to college as an adult after a significant time away from school; Taking classes with traditional undergraduate students.*
- *Vocational -- Science related former positions that are not always a close or exact match to the disciplines as taught in schools (i.e. engineering and physics, lab chemist and chemistry teacher, nursing and biology); Shifting views of profession and identity.*
- *Intellectual -- Focus of science in previous career usually leads to the need for additional broader preparation in related science fields to better fit school science areas, and state licenser requirements; Past success in science and limited view of how instruction could or should be different from what they experienced;*

The case studies developed in this paper demonstrate how barriers overlap and interact in a wide variety of ways to influence experiences in a teacher education program and into the beginning years of a new career.

Method

This paper follows three pre-service teachers who previously worked in science related fields through their science methods course, their student teaching experience, and into the first one to two years of teaching. Teacher preparation occurred at an institution in a large metropolitan city in the south eastern part of the United States. Student teaching experiences and beginning teaching positions were in urban settings or rural settings. One of these students did not do a student teaching experience but was hired under a provisional license. Individuals took a one semester science methods course, usually taken just prior to student teaching or during their first year of teaching. This course was designed for middle grades and secondary pre-service teachers, and served both traditional undergraduate students and students who held bachelor degrees in a science field seeking state liscensure. Those preparing for teaching at the high school level had a major in either: biology, chemistry, physics or earth science. Class size for this methods course ranged from 10-15 students. Three types of activities during their program provided the a comprehensive picture of how the pre-service teacher was thinking about his/her role of science teacher: Journals; Case studies; and Field Experiences/Student Teaching.

Journals

Journals represented an ongoing conversation between the instructor and the pre-service teacher. As described by Fulwiler (Fulwiler, 1987) and others, journals were used to help students develop understanding. Journal assignments were designed to have pre-service teachers reflect back on their experiences in science and science classrooms. Students were asked to describe what they think an "ideal" science lesson or unit would look like and justify their choices. The instructor prompted the pre-service teacher to consider the implications of their ideas and ideas presented in the course for the at-risk or learning disabled student. The dialog continued through the semester and into student teaching.

Case Studies

Case study methods, common in medicine and law, are gaining use in teacher education. Case materials (video and written) can provide students with practice in thinking about teaching in proactive ways. This method represents a departure from the ways in which case studies are usually used. When pre-service teachers go through an education program they often read about classroom settings, watch video tapes of classroom settings, or participate in field experiences where student learning or achievement may or may not to appear to be maximized. As instructors, we ask them to analyze what they have read or seen, describe the type of learning that has occurred, and propose ideas about what lead up to those events (Sykes & Bird, 1992). These activities help develop skills in observation, analysis and reflection. These are important skills, and during field experiences and student teaching we often evaluate them on these skills.

Case studies can also be used to attempt to move pre-service teachers from the critical but passive "they" stance in this analysis, towards a stance in which pre-service teachers place themselves in the situations under examination, and suggest and document their own preferences for teaching in a variety of situations. Several projects have developed video and or materials that were intended for (or could easily be used) in this proactive way (Martin & Marks 1995, EES/MPNE 1992, Private Universe Project 1995, NCRTL 1993, Warren & Rosebery 1994). This second type of use of case studies played a strong role in this methods course.

Field Experiences and Student Teaching

During field experiences associated with the methods class and during student teaching pre-service teachers were expected to keep a journal documenting their experiences. As a final project the student teachers prepared a portfolio of their teaching. This portfolio was designed to show their growth over time and help them begin the process of putting together a professional portfolio which they could use when seeking employment and later in their career. During student teaching and during microteaching experiences students were videotaped a minimum of two times and asked to write an analysis of the video tape.

Students who did not student teach but took teaching positions with provisional license at were required to sign up for an internship course which has almost identical requirements as student teaching. The main difference being that they were not working with a cooperating teacher and had full responsibility for the classes from the first day. This course fulfilled state requirements for a supervised and evaluated teaching experience needed for continuing liscensure.

Discussion: Moving from doing science to teaching science

Through examining journals, course assignments, video tape of class discussions, observations of teaching, interview notes and interview transcripts this paper documents how the ideas about science content, teaching strategies and science teaching of three adults entering the science teaching profession evolved over a two to four year period. Data was collected beginning with their enrollment in a science methods course and continued through the fall of 1997.

Each of the three teachers highlighted in this paper worked in science related careers before making the decision to become high school science teachers. Briefly described in the following section the three teachers highlighted in this paper will be called: Tom, Kate and Evan. The four barriers earlier described will serve as a framework for describing how these three individuals experienced their teacher education programs and shaped their initial views of science teaching. Data sources will be used to provide expanded descriptions of their teacher education experiences and the experiences they had in their first two to three years of teaching.

Tom

- *Contextual -- Issues of family, finance, employment and time.*

Tom was a white male in his late 20's when he returned to school to seek certification in Biology. Tom held a B.S. degree in food science and had worked in the meat processing field for 5 years. He had some course work toward a M.B.A. His wife was trained as an elementary teacher and had a job in a nearby rural school district where just prior to Tom's enrollment in his teacher education they had recently purchased a home.

- *Institutional -- Coming back to college as an adult after a significant time away from school; Taking classes with traditional undergraduate students.*

Tom described coming back to school as somewhat frustrating. The lack of maturity of some of his peers bothered him, especially when asked to work in small groups. He had a hard time understanding why some of his peers were not doing assigned work. He was also often frustrated by what he considered to be mere hoops that the university and state were requiring of him to become a teacher. He was confident in his biology knowledge and that he would be a good teacher -- and wondered why he had to take so many classes to be certified.

- *Vocational -- Science related former positions that are not always a close or exact match to the disciplines as taught in schools (i.e. engineering and physics, lab chemist and chemistry teacher, nursing and biology); Shifting views of profession and identity.*

Tom's former career in food science was not something that he looked back on with fond memories. Early in his marriage he had become intrigued by his wife's teaching career. He talked about teaching as being something where you could become passionate about what you were doing and where you could touch people's lives. This was very different from his experiences in food science where most of his work was done in a laboratory and where people generally worked in isolation on projects.

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- *Intellectual -- Focus of science in previous career usually leads to the need for additional broader preparation in related science fields to better fit school science areas, and state licenser requirements; Past success in science and limited view of how instruction could or should be different from what they experienced;*

Tom's preparation in food science meant that he had a fairly narrow biology background and very little background in the areas of science represented in high school science classes. For example, Tom had no previous course work in botany or ecology, he also had only minimal preparation in physics and the earth sciences. Proficiency in these topics were required for certification. A transcript evaluation indicated that he needed a significant number of additional hours in science content in addition to the courses required in teacher education. This came as a surprise to Tom who initially thought two or three courses would be all he needed to become a teacher.

Teacher Education - Shifting Perceptions of Science Content and Teaching

During the science methods course Tom began his personal struggle to accommodate his changing views of science content and what it means to teach science. The following journal excerpt was written early in his science methods course. It is his response to his instructor's feedback on the first journal response for the course. In this journal assignment students are asked to describe in detail what they would consider an ideal science lesson. Journals in this course act as a written conversation between the student and instructor.

Tom -- Journal entry (Jan. 10)

We got our first journal entry back today. I was shocked with all your questions. When you asked us to describe an ideal science lesson I thought it was a pretty silly task, but also a really easy one to do. So I described a lesson similar to one I remember from high school that I really enjoyed -- dissecting a cow eye. I figured it had all the things that make a science lesson good -- lots of information, and an activity. When you asked me questions about why I thought this would be a good lesson and what I hoped students would get out of this lesson it really bugged me. Of course this is an important thing for students to do! But as I sat down today to try and tell you why -- this is a lot harder to explain than I thought. I've spent the last 5 years working for a meat processing plant and I thought I could write a really good rationale for you -- but when I read it to my wife she thought my answer to pretty lame. So follows is my second attempt, but I want to know what your response would be to the same question if you were in my place.

Tom struggled with some of the issues that all pre-service teachers must face. As students pre-service never saw how much planning their teachers did in preparation for each class. So when pushed to consider the role of planning and identifying student prior knowledge Tom often viewed this as something that the college of education wanted him to do but that *real* teachers didn't do. He used his wife as an example for evidence of this. Tom's wife taught first grade. In class discussion he often stated that his wife didn't plan at night like we kept saying he would have to do -- she spent evening grading papers, and putting together art projects. Following is an excerpt from Tom's journal following a paper that students were asked to write after interviewing an elementary school teacher, a middle school teacher and a high school teacher. In the interview teachers were asked to describe a typical teaching day, and describe how the teacher made decisions about content and teaching strategies used.

Tom March 10 (journal excerpt)

> *OK...OK.... so you told me so....teachers may not always write it down -- but most of them do spend a lot of time and energy planning.. I couldn't believe how different each of these schedules were and how differently these people talked about their jobs. I'll write you more about this later -- I'm wondering about how you prevent burnout?*
>
> *For my paper I interviewed my wife for the elementary position, a neighbor for the middle school teacher and Mr. Dickson* (a teacher who's class was visited during the methods course). *These three teachers had really different kinds of days. Katie has 30 students that she works with pretty much all day and she takes them through all of the subjects, the only break she has is when they are at recess or music and then only if she doesn't have to supervise that day. I knew this at one level but I had never really considered how different this would be from my future job. Sarah, my neighbor, teachers 8th grade social studies -- she has 6 classes a day, each one with 25-30 students and has to work with the other members of her team during planning time. Her class is suppose to "mesh" with the other teacher's classes. Mr. Dickson is on block schedule so he teaches 3 classes a day -- but each one is 90 minutes.*
>
> *But the main thing that was common between them hit me really hard they had all planned more than I thought. I guess I thought if you had a state and local curriculum you just followed it, covered the stuff in the book and that was good enough planning. I really didn't believe that teachers had to plan much. When they shared their lesson plans -- most of these teachers just had a few words written down in their lesson plan books. But when I asked the "why" questions they could give me a lot of background information about their students, how concepts are developed, difficulties that students were having and would have in the next few days, etc.... Sometimes it was hard to get them to stop talking about why they made those decisions! What really shocked me was that the planning wasn't just focused on the topics but on the students in the class. Several times they told me how this year's class was different than last year's class and how that changed their teaching. So I guess that comes with time --- right?*

Micro teaching and field experiences that had students teaching lessons in classrooms appeared to have a strong impact of views of teaching. Tom is an example of a person who was strongly influenced by one of his microteaching experiences to his peers. Following is a journal response where he discusses this event.

Tom April 22 (journal excerpt)

> *OK -- so teaching is a lot harder than I thought it would be. I couldn't believe the blank looks of the people in our class when I did my micro-teaching lesson on nutrition. I thought these people knew science -- but I blew them away with all the vocab. If biology, chemistry and physics majors had trouble with it, high school students would really have been lost.*
>
> *I asked Sarah about her confusion after class -- I know she's a biology major and I really expected her to understand the biochemistry I was talking about. She told me she's never had much biochem, but that she has had a variety of courses in plant and animal physiology but they had never covered things in that much detail. Vicki said her chemistry major had very little biochem in it -- more inorganic, organic and physical chemistry.*
>
> *When you pushed me to look at state and national curriculum guidelines and typical high school textbooks I discovered the topic is hardly covered at all. But this is the fun stuff of biology -- I don't want to have to teach all those other topics like cells and photosynthesis! I thought -- Yuck! That's boring. But that was also the feedback I was getting from my peers during my microteaching.*

This event really bothered Tom in the coming weeks. The idea that what he thought was interesting and important to learn would not be perceived by his peers in that way really shook him up. He expected this type of reaction from high school students and had written about strategies that he planned on using in his classroom to overcome initial student resistance. It really surprised him that his peers, who had strong science backgrounds, could have this negative or type of reaction to a topic that he thought was obviously important and relevant really challenged his views of what teaching science really meant. This event forced him to examine what was important to teach, how content is structured and how to make science more relevant to students in ways that no other course activity had challenged him.

Becoming a teacher:

The following brief description describes how Tom's ideas about teaching changed during the first year and a half of full time teaching. Tom did not student teach, partially due to some financial concerns, and partially due to his view that he didn't need the support provided during student teaching. Tom took a position in a rural school district teaching biology, ecology and physical science the fall following the methods course. The following interview and journal excerpts provide insight into some of the struggles that Tom faced during that first year and into his second year of teaching.

Tom -- Sept. 12th (interview excerpt)

I can't believe how much material we are expected to cover. The curriculum director gave me the course of study a couple days after I accepted the position. We are suppose to cover about a chapter a week in biology. The list is about as long for the other classes I'm teaching but we don't even have a book for those classes. I can't believe how much work all of this is -- I'm spending so much time at the library trying to find materials. I never really thought it would be this hard. At first I thought -- hey no problem -- but these kids can't read, and won't do their homework. If they don't do well on the end of course test -- I don't have a job next year . It just doesn't seem fair! Teachers sure put up with a lot of crap.

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Sure wish I could have student taught -- maybe then I would have more help available. Doing it this way -- I'm on my own. No one really has the time to help me much. When you made the offer to help -- I didn't even know what to ask you for help with! I never thought teaching was so isolated...

Tom -- May 8th (journal excerpt)

Well I've almost made it -- just a few more weeks. I think this has been the longest year in my life. A few students from (the university) have asked me about how you get a job without student teaching and I keep telling them DON'T DO IT. Sure the money sounds good -- but it is so hard to do without support. There was a student teacher in the room next to me this spring and I was so envious of all the support he got. People kept dropping by giving him advice and helping him find resources. No one did that for me last fall -- I was hired to be a teacher and I was expected to know what to do.

Don't get me wrong -- I still think I want to be a teacher and my contract has been renewed so I'll be back. But I also know what I'll be doing this summer -- it won't be playing baseball and painting houses like I thought it would be at the beginning of the year -- it will be planning next years classes. I never felt like I was keeping up this year. So about that independent study you said I could work on.....

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Tom -- September 10th (interview excerpt - second year of teaching)

So far things are going a little better than they did last year. I'm teaching the same classes as I taught last year -- so I'm feeling a little more comfortable. This summer I took a couple classes from the geology department and I think that will really help. I also took a couple workshops on problem based teaching and using technology in the classroom. I knew from your class that these things were out there -- but I never thought I'd be spending my weekends and summers PAYING to go back to school. I figured once I got my certificate I'd be done with school.

I have to admit a couple years ago when Katie wanted to take one something during the summer I gave her some grief about goofing up our summer and how much money it would cost. Now I'm eating those words...and she was quick to call me on it last spring when I told her what I wanted to do.

I really like teaching though..this is what I want to do. I couldn't ever go back to working in the meat industry again. But there was a time last spring when I really thought about it. The money in teaching is pretty bad and you end up spending a lot of your own money on things. There was a time there that I really doubted if it was worth it. I missed an 8 hour a day job. Katie and I discussed it, and I don't think I told you this last spring but I actually applied for a job like that and had an interview. I knew before I left the place -- I didn't want to go back to that kind of work. I LIKE working with kids ... it means something.

Kate

- *Contextual -- Issues of family, finance, employment and time.*

Kate came to teaching a bit later than most of her peers. When Kate started the teacher education program she was in her mid 40's, married to a physician and the mother of two high school students and two younger children. Kate had worked as a registered nurse prior to the birth of her first child. At that time she left full time nursing and took on primary care of her children. Occasionally helping out in her husband's practice in times of illness or vacation. As her children got older and with the prospects of college bills for her children in the near future Kate decided that she needed to go back to work full time and decided that she wanted to become a high school biology teacher.

- *Institutional -- Coming back to college as an adult after a significant time away from school; Taking classes with traditional undergraduate students.*

Kate discovered during her first semester back in classes for certification that going to school was going to be much more difficult than she had anticipated. She often talked about how in the early semesters of her program it was difficult to get back into the routine of taking classes. Some

of her fellow classmates were just slightly older than her children and had science experiences in high school very different from her own. Even with her degree in nursing she sometimes felt at a disadvantage in some of the science classes. At other times she was frustrated by the fact that some of her fellow students did not take things seriously. Their immaturity and what she perceived as lack of respect for adults she found very troubling. Class times often conflicted with family routines. The time needed for study often took longer than she anticipated and forced her to make hard decisions between doing things for her family and completing assignments on time and with quality.

- *Vocational -- Science related former positions that are not always a close or exact match to the disciplines as taught in schools (i.e. engineering and physics, lab chemist and chemistry teacher, nursing and biology); Shifting views of profession and identity.*

Like many of her peers who move from science related careers to teaching science Kate believed that her background in nursing would provide her with all of the content knowledge that she needed for teaching biology. Her strong background in anatomy and physiology was similar to her memories of the content of high school science classes. As a nurse she was very accustom to using her science knowledge, applying it and communicating information to others (nurses and doctors) as a routine part of her work. Because a great deal of her training had focused on the memorization of a large number of symptoms, and practicing of skills this was also her view of what it meant to learn and understand science. Learning science was memorizing facts and practicing skills.

- *Intellectual -- Focus of science in previous career usually leads to the need for additional broader preparation in related science fields to better fit school science areas, and state licenser requirements; Past success in science and limited view of how instruction could or should be different from what they experienced;*

When inquiring into what would be required to take to become a biology teacher Kate was very surprised to find out that she would have a significant number of content courses to take for certification. Kate found herself taking courses similar to those of her high school aged children

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and struggling with topics such as genetics, botany, physics and advanced chemistry. She was surprised to find out that all high schools didn't offer advanced anatomy and physiology and that she could not plan on teaching only those topics. Proficiency in a broader range of topics were required for certification. A transcript evaluation indicated that she needed a significant number of additional hours in science content in addition to the courses required in teacher education. Similar to Tom, this came as a surprise to Kate who also initially thought two or three courses would be all she needed to become a teacher.

Teacher Education - Shifting Perceptions of Science Content and Teaching

When Kate decided to return to school to become a certified science teacher she was surprised to find out how much additional science she would have to take. Prior to starting the teacher education part of the program she had a large number of science courses to take. During advising sessions she would often try to find out why she needed these classes and if there was any way that she could omit these advanced science courses from her program.

She found it uncomfortable to take science classes students close to her own children's age and if the topic did not fit what she knew her children were taking in school she often doubted the need for a more complex understanding of science. Following is a journal entry from her first week in science methods. The journal is in response to the question: What do you hope to learn or what skills do you hope to have when you leave this class that you do not currently posses?

> *Sept. 5 (journal excerpt)*
> I am hoping that I know strategies for teaching science when I am done with class. So far I have taken some general courses in education -- but they seem to be mostly geared toward elementary teachers and I want to teach only at the high school level.
>
> **********
> I want to know things about setting up labs, ordering things, classroom safety and discipline. Things like that are what should be the main focus of a teacher education program and so far I haven't had any of that and I plan on student teaching next semester. So far I taken a lot of science classes that I know I won't be able to use with my students and I think these classes have been a waste of my time and money. I work with my kids every night on their homework and I know what kinds of things they are doing. I'm hoping in this class I finally learn those things I need to be a teacher.

Kate's view of science and science teaching was also strongly influenced by her past work as a nurse. In the nursing training that she had received she was expected to learn a lot of details and skills. There was also almost always someone in authority who would make most of the major decisions on care and treatment. This past history was evident in both her course and field work. In response to a journal question about describing her ideal science lesson. Kate wrote the following two responses:

Oct. 12 (journal excerpt)

> I think in an ideal science lesson in biology. I would have a whole series of x-rays, or NMR scans that each student in the class could have to take home and study. We would use these images to identify the parts of the body. For the test, given any x-ray, students would be able to identify the bones and the approximate age or physical condition of the person.

Oct. 20 (journal excerpt)

> In last weeks journal you asked me *how* the students would learn about the bones for me ideal lesson. I guess I don't really understand your question. What do you mean "how"? In science you always have to memorize lots of material. Sometimes you can do it with study cards, or other tools and I don't want to tell me students how they have to learn something. Everyone learns things their own way.
>
> When my son learned about this a couple years ago. His dad and I drilled him on all the bones every night. The only way we could get him to study this was to work with him. My husband and I both talked about it that it would have been better if student had something other than their book to study from, so that is why I said I'd use x-rays and other scans to teach anatomy on physiology. What students learn isn't tied that closely to what the teacher does. When students are in high school they need to learn to take responsibility for their own learning. If they can't do that for themselves then it is the job of parents to help their students master the information presented in school. Teacher's just set the topic or task and it is up to students and their parents to figure out the "how" part. In college you have to do things on your own. Professors give you information in lectures and expect you to read and then you're tested. High school should prepare students to be able to do this.

Kate did not student teach spring semester as she had planned. She signed up to student teach but withdrew after about three weeks of student teaching. One of the things that she quickly discovered that semester was that her family life had to undergo some fairly dramatic changes if she was to successfully complete her student teaching. Kate was forced to face that fact that when she took a teaching position these changes would not be temporary but part of a new life style. After two weeks of student teaching Kate was close to both a physical and mental collapse. She

was getting on average 3-4 hours a sleep a night. She had not yet picked up the full teaching load and had real doubts if she was capable of doing so.

The largest dilemma that Kate faced was that as a family they had not thought about what it would mean for Kate to no longer have a flexible schedule or the number of hours available to do family related things. While she was taking college courses she had been able to schedule most of her courses around the needs of her family. In student teaching the schedule was dictated. Her children had a hard time accepting that she could not take them to school if they slept in and missed the bus, or immediately come and get them after school if they had stayed after for an activity. Kate had done all of the domestic duties around the house and in the early days of student teaching she was shocked to find out that her husband and children didn't know how to run the microwave, the dishwasher and washing machine. When she made the decision to drop out of student teaching for a semester she told the field placement office that she needed time to train her family how to do some basic things around the house and learn how not to "need her quite so much."

The following fall after spending time in the spring and during the summer helping her family learn some new skills and responsibilities around the house she began her student teaching experience. She had made arrangements the previous spring to spend 2-3 days a week with the person who would be her cooperating teacher in the fall. This was the same person that she had started with the previous spring. By spending those two to three days a week in the school and working with the cooperating teacher she was able to both work on the family issues that had reached almost crisis level and co-plan and teach during the spring. In doing this she gained more confidence in her teaching and greater familiarity with the school. When she started her student teaching that fall she did not face some of the initial uncertainties student teachers often face. The school she student taught at was on a block schedule. So the units and topics she had worked with the cooperating teach on during the spring were also the courses and topics that she taught in the fall. The following journal entry shows that student teaching was not a real easy experience for her but that the extended field experience in the spring had been a great benefit.

November 17th (Journal excerpt)

I can't believe that student teaching is almost over. It is going to be hard to leave this school at the end of this semester. Teaching is a lot more work that I thought it would be. I really struggled last spring when I realized that some kids don't do homework. When I saw it last spring I didn't understand why Carol (her cooperating teacher) wasn't calling home or doing more to get these kids to do their work. This fall I discovered that it doesn't usually matter if you call home. Some parents just don't care. They think it is the teacher's job to get kids to work, not theirs!

In some ways it has been like the battle with my kids and husband -- getting them to understand that some thing's are "family chores" not just things that mom does. The past nine months have been like a long pregnancy -- but this time instead of the baby the result will be me getting a full time job. Just like with pregnancy though I'll lives will change for ever. Sometimes I think my family has been treating this like a bad case of flu though. They still think things will get better once I'm done with student teaching. I honestly don't think things will change much.

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I still don't think that I am doing a great job with my teaching. But I think I am doing adequate. There is so much more I wish I could do for my students. I hate doing "adequate" I'm a perfectionist and this just doesn't feel very good. Lot's of times this fall I feel like I've been trapped. If I'm doing something for my kids at school that I can't be doing something for my own family. If I do family things than I'm doing things for my students. Either way some one looses.

Becoming a teacher:

Kate was hired by the same school district but at another school for a position that began the following January. So Kate moved directly from student teaching into her first year teaching position. The following interview transcript comes from a conversation the following fall.

Sept. 25 (interview transcript)
Things are really going pretty good these days. I really like my school and the other teachers at the school are great. I finally sort of feel like a teacher. I didn't realize that teachers had to make so many decisions every day. In the beginning that really surprised me. During student teaching my cooperating teacher always helped me and sort of told me what to do. I thought the department chair told her these things and we were just following orders.

Last spring was a real eye opener for me. I found out that I was expected to make a lot of decisions and had quite a bit more freedom that I thought. That was real scary to me -- cause I also knew that if I goofed up -- it was my fault and I would take the fall for it.

When I started my job last spring I realized how much of my cooperating teacher's advice to me and her reputation in the school had shaped the class. The first four weeks of the job were like a zoo! Kids tried things that I remembered later we had talked about in class -- but I never saw last year. Some of the things in class that we had discussed that I thought were pretty much common sense came rushing

> back to me. I also finally figured out WHY we needed all the science we had -- some kids don't just answer questions -- they ASK them. I don't mean stuff out of their book -- I mean they sometime ask HARD questions. My ideas about what it means to be a teacher have really done some major changes in the last couple of years.

Evan

- *Contextual -- Issues of family, finance, employment and time.*

Evan was in his early 30's when he began his teacher education program. Prior to starting his teacher education program to become a high school physics teacher Evan worked as an electrical engineer. During his teacher education program Evan and his wife purchased a new home. Evan had moved from a full time engineering position to doing some part time consultant work while in the teacher education program, with the plan of stopping all extra consultant work during student teaching. Evan knew coming into the program that his salary as a teacher would be considerably less than he made as an engineer, and his decision to leave engineering was a decision that he and his wife had made together. Evan had previously done some volunteer work tutoring students after school and in his journals would often talk about his need to help and work with young people.

- *Institutional -- Coming back to college as an adult after a significant time away from school; Taking classes with traditional undergraduate students.*

This did not appear to be a significant barrier for Evan. Evan truly enjoyed the academic challenges of learning new topics and viewed working with and sometimes tutoring his peers in these courses as an opportunity to work on his teaching skills. Evan took several courses that were not required because he had an interest in the topics and thought they would be useful to him as a high school teacher.

- *Vocational -- Science related former positions that are not always a close or exact match to the disciplines as taught in schools (i.e. engineering and physics, lab chemist and chemistry teacher, nursing and biology); Shifting views of profession and identity.*

This barrier, as originally described, was a place holder for talking about the differences in course work and preparation between fields that look similar to school courses but differ in some not so obvious ways. During course work this did not appear to be a barrier for Evan, but as a later description of his student teaching experience will illustrate this barrier and the implications of this barrier need further exploration. Evan's experiences highlight how difficult it can be to assess during teacher education coursework how pre-service teachers translate what they know and understand into practice.

- *Intellectual -- Focus of science in previous career usually leads to the need for additional broader preparation in related science fields to better fit school science areas, and state licenser requirements; Past success in science and limited view of how instruction could or should be different from what they experienced;*

Evan had a very limited number of courses to take in the content areas to meet the requirements for certification. When a transcript analysis for certification in physics and mathematics was completed Evan was told he only needed to take one additional physics course. Evan felt that he was rusty in some of the earlier courses in both mathematics and teaching that he elected to take additional courses on a non-credit basis. The majority of the course work that Evan needed was in the College of Education. These courses pushed Evan to think about teaching and content in some new ways. One of the differences that Evan spoke about was that most of the mathematics and science course work and work experiences were more individual experiences, in contrast to education classes often emphasized cooperative learning and learning as a social experience. Evan's experiences tutoring and doing volunteer work with high school and college students had prepared him for the wide variety of students sometimes interpret text and teacher presented material. Evan often asked for advice on where he could learn more about different types of teaching strategies and learning styles.

Teacher Education - Shifting Perceptions of Science Content and Teaching

Evan's story is differs from the other stories presented in this paper. Where the earlier cases described some difficulties and frustrations in the early stages of teacher preparation for the most part this was not the issue for Evan. His course work and writings did not indicate any potential problems. Evan wrote quite eloquently about the role of teachers and how he saw himself as a teacher. His microteaching and field experiences indicated that he would be a creative, reflective teacher. Student teaching brought to light hidden barriers that neither Evan, his cooperating teacher or his university instructors had anticipated.

Evan's student teaching experience was in a high school that had an International Baccalaureate Program (IB) that was on a block schedule (classes were 90 minutes long, met every day), his assignment was general physics, Advanced Placement Physics and IB Physics. All three of these courses covered the same themes and ideas but differed in student expectations and the role of writing and experimentation differed in the three courses. The majority of his students had histories of being highly successful in school. From an outsider's perspective what would appear to be an ideal setting for student teaching.

Evan observed at worked with his cooperating teacher for the first two weeks of the semester and made plans for when he would start picking up classes during the third week. He appeared to be developing a strong repertoire with the students and both his cooperating teacher and student teaching supervisor were pleased with the way things appeared to be starting. During the third week Evan picked up his first class. His first class was the general physics course, this class had approximately 20 students enrolled. He came up with a variety of very creative ways of working with these students and the only thing that both his cooperating teacher and student teaching supervisor notices was that he still appeared a bit nervous in front of the students. He picked up on suggestions of incorporating more group work and having students taking on more presentation responsibility. This allowed him to step back a bit more and appeared to relieve his anxiety a bit. He taught this class almost 2 weeks before picking up the AP Physics course.

Toward the end of the second week of this schedule (6 weeks into student teaching), and just before he was scheduled to pick up the third course Evan's cooperating teacher and student teaching supervisor started noticing some things that raised concern. During a formal observation that week, Evan's classroom presence and ability to respond to student questions seemed markedly different from previous observations. He appeared to be easily thrown by student questions and his self-confidence appeared to be much lower. Students were beginning to challenge his authority and test him as is common during student teaching and Evan did not appear to be coping with this. If students did not work the problems the way that he had modeled he had difficulty evaluating if the process was correct. He felt he modeled the "easiest/shortest" way of solving the problem and his students often had difficulty following how he had worked the problems.

During a post observation conference it was clear that Evan knew this was happening, but did not have any plans for addressing these concerns. He explained that on average it was taking him 8 to 12 hours a night to grade papers and plan for the next day, leaving him very little time for sleep or other parts of his life. Each evening he was trying to figure out all the different ways his student *might* solve the problem so that he could be ready for them the next day. He spent so much time evaluating the day that had just passed that he felt rushed to prepare for the coming day. That the students were starting to challenge him and question him with their own suggestions also bothered him. His tutoring and earlier field experiences had not prepared him for the determined way that some students, especially academically successful students took him by surprise. These students have a level of self advocacy skills often missing in general education students.

Evan's cooperating teacher and student teaching supervisor had some concerns as did Evan about how he would cope with a full load and postponed his picking up the third course for another week. This action was taken with the belief this would give him some additional time to develop some coping strategies and self confidence needed to teach a full load. The end of that week did not indicate any improvement, so the suggestion was made that he co-teach the third course with his cooperating teacher thus sharing the planning and teaching responsibilities during

the 8th week of student teaching. During this time Evan's ability to cope with his other classes also started to deteriorate.

Evan called his cooperating teacher over the weekend between his 8th and 9th weeks and told her that he was withdrawing from the student teaching program. That weekend Evan had been paralyzed by the work and needs of his students and did not feel that he could face the students on Monday. The previous Thursday his cooperating teacher and supervisor had spoken to Evan about their concerns for his health, and had recommended he take some time that weekend, and to not come in on Friday, to devote just to his own health and well being, with the belief that once he got some rest he would be OK. Evan's self reflections over the weekend lead him to the decision that teaching was not for him, and that he would return to engineering.

The two previous individuals described in this paper we individuals who over came and/or learned to live with the barriers that they faced in moving from a science related field to teaching. They both describe the transition as difficult, but in the end rewarding. Both Tom and Kate now a couple years after leaving the teacher education program talk with pride about what they are doing and about the rewards they get from teaching.

Evan differs from his peers it that he appeared to excel in a teacher education program, yet when faced with the day to day realities of teaching it was some of those same skills, and high goals and expectations for his students that forced him to leave teaching full time in public schools. Evan is currently working for the same engineering company that he had previously worked in, but he has not left teaching entirely. Evan's choice to return to engineering and not continue to complete his student teaching experience and continue on as a high school teacher was a painful and difficult decision. Evan felt that teaching was something that he was meant to do, he sometimes described it as a form of religious calling that he felt compelled to heed. To leave teaching and he did challenged his view of his identity. Through extensive discussions and conversations with people in the College of Education, his pastor, and other friends Evan discovered that one way of meeting this need is to volunteer as a tutor for students in his church and at a local high school.

Conclusion

Student journals and interviews indicate that journals, case studies and field experiences are effective ways of shifting views of science and science teaching. This paper documents how the perceptions about what it means to teach science of three pre-service teachers who had previously worked in science related fields evolved as they moved through a science methods course, into their student teaching experience and then into their first two years of teaching. These three stories are only a beginning of documentation of some of the barriers and ways that individual cope with the barriers of becoming a teacher.

One way of examining these barriers is to compare how these barriers may differ between a career transition teacher and a more typical undergraduate student who lives on or near campus.

Contextual -- Issues of family, finance, employment and time.

Undergraduate	***Career Transition***
• Searching for identity, finding own voice	• Has a strong family role and duties - sometimes modified with return to school
• Student loans	• Mortgages, household bills, college bills
• Part time jobs	• Part time jobs, or severe drop in income
• Establishing life goals, priorities	• Re-examining life goals, priorities

Institutional -- Coming back to college as an adult after a significant time away from school; Taking classes with traditional undergraduate students.

Undergraduate	***Career Transition***
• Exploring options, majors	• Meeting requirements for liscensure
• Learning material for first time or expanding high school knowledge	• Re-learning material, learning advances and changes in field.
• School and associated social life as a lifestyle	• School as a way of getting on with a different phase of life, interfering a modifying current life style

Vocational -- Science related former positions that are not always a close or exact match to the disciplines as taught in schools (i.e. engineering and physics, lab chemist and chemistry teacher, nursing and biology); Shifting views of profession and identity.

Undergraduate	***Career Transition***
• Earning degree in content science field: Biology, Chemistry, Physics, Earth Science, etc..	• Applied science major earned: Nursing, Engineering, Horticulture, etc...
• Focus on content areas	• Focus on application and products or skills

Intellectual -- Focus of science in previous career usually leads to the need for additional broader preparation in related science fields to better fit school science areas, and state licenser requirements; Past success in science and limited view of how instruction could or should be different from what they experienced;

Undergraduate	***Career Transition***
• Science teaching as experiences in high school	• Science teaching as experiences in high school or as experienced by their children

This listing is not comprehensive but is placed here as a beginning comparison. Additions, deletions, modifications from readers welcomed and needed. If we can develop a clearer understanding of how career transitions pre-service teachers differ from more traditional undergraduate students we can start to develop programs that better meet their needs and the needs of the schools where they are taking teaching positions.

Developing a deeper understanding of these issues and exploring different ways of shaping our programs will also benefit many of our undergraduates who may be transferring in from community colleges, or who face similar family issues. Many of these individuals come with life experiences that make them valuable members of the teaching profession. If we continue to ignore their needs we will loose their contributions.

Each year promising individuals decide to explore science teaching as an alternative to their current careers. They bring with them a wealth of science experience with them. Current programs often do little to support them in this career transition. Most states and school districts are only recently starting to explore ways of supporting new teachers and they begin their careers. Therefore, each year we loose promising student teachers and novice teachers who as they gain experience in the classroom decide this is not what they want to do as their careers. In the long run though the stress of constantly feeling that teaching and learning is a battle between teachers

and students prompts promising new teachers to leave the profession. Below are listed a few questions that I believe we need to explore further. The first question is most relevant to the career transition teacher and the others apply to all of our pre-service teachers:

- How can we address the special needs of individuals who are making a career shift?
- What other strategies can be incorporated into pre-service education that would prepare pre-service teachers for the wide variety of students?
- Is it possible to love science too much to be able to teach it at the high school level?
- How are the barriers described in this paper similar or different from non-traditional undergraduate pre-service teachers?
- What steps can be taken to support student teachers and beginning teachers in high schools so that they continue in the profession?

Another set of questions that haunts this science educator is:

- What other experiences need to be added to a teacher education program to help people like Evan who seem to excel in the course work but who when faced with day to day teaching responsibilities fall apart?
- What traits or characteristics should signal potential problems such as those faced by Evan?

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If any of you are also wrestling with these kinds of issues and would like to continue the dialog started by this paper I'd love to hear from you and explore ways we support each other in examining these issues.

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